

REMARKS

Claims 1, 7-9, 15-17, 19, 29, and 30 have been amended, and claims 21-28 have been cancelled. Accordingly, claims 1-2, 7-10, 15-20, and 29-30 are pending in the present application. The claim amendments are supported by the specification as originally filed, with no new matter being added. Accordingly, favorable reconsideration of the pending claims is respectfully requested.

Applicants have amended the specification to correct minor typographical errors and for clarity.

1. Rejections Under 35 U.S.C. § 112

Claims 21-28 and 29-30 have been rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter not sufficiently described in the specification. In addition, claims 21-28 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Applicants respectfully traverse.

Applicants note that claims 21-28 have been cancelled, so the rejections of these claims under 35 U.S.C. § 112 is now moot.

Claims 29 and 30 have been amended to delete the term "adsorbed" in conjunction with the nitrogen-containing silane, since the Examiner objected to the use of this term. Thus, Applicants respectfully request that the rejection of claims 29 and 30 under 35 U.S.C. § 112 be withdrawn.

2. Rejections Under 35 U.S.C. § 102

Claims 1, 9, 17, 19, 21, 24, and 27-30 have been rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,861,675 to Sasaki et al. (hereinafter "*Sasaki*") for the reasons stated on pages 3-4 of the Office Action. Applicants respectfully traverse.

Applicants note that claims 21, 24, 27, and 28 have been cancelled, so the rejection of these claims under 35 U.S.C. § 102(e) is now moot.

Claim 1 has been amended to recite that the passivation layer comprises "nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption." Support for this recitation in claim 1 can be found in the application as filed on page 15, lines 8-11. There is no teaching or suggestion in *Sasaki* of a passivation layer comprising "nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption" as recited in present claim 1. Rather, *Sasaki* discloses that a tungsten nitride film containing fluorine is formed as a barrier in the contact hole of a semiconductor device with no teaching of what if any type of adsorption is present.

Independent claim 9 has been amended to recite that the passivation layer is "formed by exposing said upper surface to a plasma consisting essentially of a nitrogen-containing silane." Support for this recitation in claim 9 can be found in the application as filed on page 17, lines 4-7. There is no teaching or suggestion in *Sasaki* of such a claimed feature as recited in claim 9. Rather, *Sasaki* discloses that ammonia, silane, and tungsten hexafluoride gases are used to produce a tungsten nitride film containing fluorine. These deposition gases in *Sasaki* are provided under conditions that would not produce a plasma (*see* col. 6, lines 1-19). In fact, the only disclosure in *Sasaki* of the use of a plasma is in the formation of a silicon dioxide film by plasma CVD (*see* col. 14, lines 9-11).

Independent claims 17 and 19 have been amended to recite that a second passivation layer comprises "multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption." Support for this recitation in claims 17 and 19 can be found in the application as filed on page 15, lines 11-14. There is no teaching or suggestion in *Sasaki* of such claimed features as recited in claims 17 and 19. Rather, as discussed previously, *Sasaki* discloses that a tungsten nitride film containing fluorine is formed as a barrier in a semiconductor device, with no teaching of what if any type of adsorption is present.

Independent claim 29 has been amended to recite a passivation layer "consisting essentially of a nitrogen-containing silane." Independent claim 30 has been amended in a similar fashion. There is no teaching or suggestion in *Sasaki* of a passivation layer "consisting essentially of a nitrogen-containing silane" as recited in claims 29 and 30. Rather, *Sasaki* discloses that a tungsten nitride film containing fluorine and silane is formed as a barrier in a semiconductor device. As the Examiner is aware, the terminology "consisting essentially of" recited in claims 29 and 30 limits the passivation layer to nitrogen-containing silane and other unrecited elements that do not materially affect the basic and novel characteristics of the recited passivation layer. Thus, a passivation layer "consisting essentially of a nitrogen-containing silane" as recited in claims 29 and 30 does not read on the tungsten nitride film containing fluorine and silane as disclosed in *Sasaki*.

Accordingly, for the above reasons, claims 1, 9, 17, 19, 21, 24, and 27-30 are not anticipated by *Sasaki*. Applicants therefore respectfully request that the rejection of these claims under 35 U.S.C. § 102(e) be withdrawn.

3. Rejections Under 35 U.S.C. § 103

Claims 1-2, 7-10, and 15-20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,780,908 to Sekiguchi et al. (hereinafter "*Sekiguchi*") in view of U.S. Patent No. 6,077,774 to Hong et al. (hereinafter "*Hong*") for the reasons set forth on pages 5-6 of the Office Action. In addition, claims 1-2, 7-10, and 15-20 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Sekiguchi* in view of U.S. Patent No. 6,114,238 to Liao (hereinafter "*Liao*") for the reasons set forth on page 6 of the Office Action. Applicants respectfully traverse.

As discussed previously, claim 1 has been amended to recite that the passivation layer comprises "nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption." Independent claim 8 recites similar features. There is no teaching or suggestion in *Sekiguchi*, *Hong*, or *Liao* of such recited features for a passivation layer, and no teaching of what if any type of adsorption is present.

Independent claim 7 has been amended to recite that a second passivation layer comprises "multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption." As discussed above, independent claims 17 and 19 have been amended to recite similar features. There is no teaching or suggestion in *Sekiguchi*, *Hong*, or *Liao* of such recited features for a second passivation layer.

As discussed previously, independent claim 9 has been amended to recite that the passivation layer is "formed by exposing said upper surface to a plasma consisting essentially of a nitrogen-containing silane." There is no teaching or suggestion in *Sekiguchi*, *Hong*, or *Liao* of forming a passivation layer from a plasma consisting essentially of a nitrogen-containing silane. Rather, *Sekiguchi* discloses using a nitrogen or ammonia plasma to form a tungsten nitride layer.

Hong discloses use of an anneal to form metal oxide or carbide layers, and *Liao* discloses use of an anneal to form a metal nitride layer.

Independent claim 15 has been amended to recite a second passivation layer "consisting essentially of a nitrogen-containing silane." Independent claim 16 has been amended in a similar fashion to recite a passivation layer "consisting essentially of a nitrogen-containing silane." There is no teaching or suggestion in *Sekiguchi*, *Hong*, or *Liao* of a passivation layer "consisting essentially of a nitrogen-containing silane" as recited in claims 15 and 16.

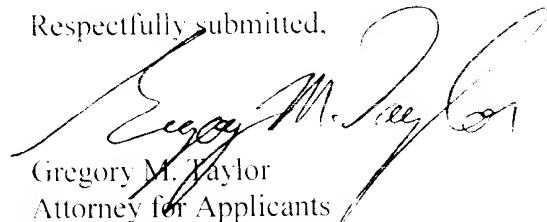
Accordingly, for the above reasons, claims 1, 7-9, 15-17, and 19, as well as dependent claims 2, 10, 18, and 20, would not have been obvious over the cited references. Applicants therefore respectfully request that the rejection of these claims under 35 U.S.C. § 103(a) be withdrawn.

CONCLUSION

In view of the foregoing, Applicants respectfully request favorable reconsideration and allowance of the present claims. In the event the Examiner finds any remaining impediment to the prompt allowance of this application which could be clarified by a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney.

Dated this 5th day of June 2002.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW THE CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at page 7, line 2 of the specification has been amended as follows:

In order [that] to illustrate the manner in which the above-recited and other advantages of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered [to be] limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

The paragraph beginning at page 9, line 11 of the specification has been amended as follows:

In reference to Figure 2, prevention or reduction of the likelihood of oxidation of upper surface 16 of interconnect 12 is accomplished during the formation of ILD layer 18. This is carried out by an *in situ* passivation of upper surface 16 of interconnect 12, immediately prior to or simultaneously with the formation of ILD layer 18, which avoids the problems of the prior art.

The paragraph beginning at page 10, line 4 of the specification has been amended as follows:

The chemical compound is provided in an amount sufficient to substantially chemically cover upper surface 16 of interconnect 12 in order to chemically protect approximately the first 1-1,000 atomic lattice layers thereof. The chemical compound may be a nitride form of the metal of which interconnect 12 is composed. Where ammonia, a hydrated nitrogen compound or the like is used, a chemical structure such as $M-N-H_x$ forms, where M represents the metal of which interconnect 12 is composed.

The paragraph beginning at page 17, line 16 of the specification has been amended as follows:

Following the formation of ILD layer 18, further processing is carried out as illustrated in Figure 5. Second depression 34 is formed into ILD layer 18 by patterning and etching thereof. In a damascene process such as that illustrated in Figure 5, second depression 34 is formed substantially above interconnect 12. Second depression 34 may

be, by way of non-limiting example, a wiring trench such that metallization within second depression 34 would run in and out of the plane of Figure 5. Additionally, second depression 34 may be a contact corridor such that metallization would run left to right, substantially within the plane of Figure 5 along the upper surface 36 of ILD layer 18 and filled into second depression 34 such that a metallization line with a contact is formed, whereby the contact is in electrical communication with interconnect 12.

The paragraph beginning at page 18, line 1 of the specification has been amended as follows:

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as [illustrated] illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims and their combination in whole or in part rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

IN THE CLAIMS:

Claims 1, 7-9, 15-17, 19, 29, and 30 have been amended as follows:

1. (Thrice Amended) A semiconductor structure comprising:
 - an electrically conductive interconnect disposed within a first dielectric layer, said electrically conductive interconnect having an upper surface;
 - a passivation layer disposed upon said upper surface, said passivation layer comprising [ammonia and derivatives thereof] nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption; and
 - an interlayer dielectric disposed upon said first dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.

7. (Thrice Amended) A semiconductor structure comprising:
 - an electrically conductive interconnect having an upper surface and being disposed within a dielectric layer, said electrically conductive interconnect including:
 - a titanium liner layer disposed within a depression in said dielectric layer;
 - a titanium nitride layer disposed upon said titanium liner layer; and
 - a tungsten film disposed upon said titanium nitride layer and filling said depression;
 - a first passivation layer comprising a tungsten nitride compound and being disposed upon said upper surface.

a second passivation layer comprising [ammonia and derivatives thereof] multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption; and

an interlayer dielectric disposed upon said dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.

8. (Thrice Amended) A semiconductor structure comprising:

an electrically conductive interconnect disposed within a dielectric layer, said electrically conductive interconnect having an upper surface and including:

a titanium liner layer disposed within a depression in said dielectric layer;

a titanium nitride layer disposed upon said titanium liner layer; and

a tungsten film disposed upon said titanium nitride layer and filling said depression;

a passivation layer disposed upon said upper surface and comprising [ammonia and derivatives thereof] nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption; and

an interlayer dielectric disposed upon said dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.

9. (Thrice Amended) An interconnect in an electronic device comprising:

a metallic first structure disposed within a first silicon oxide layer, said metallic first structure having an upper surface;

a passivation layer disposed upon said upper surface, said passivation layer [comprising ammonia and derivatives thereof adsorbed upon said upper surface] formed by exposing said upper surface to a plasma consisting essentially of a nitrogen-containing silane; and

a second silicon oxide layer disposed upon said first silicon oxide layer and upon said upper surface, said second silicon oxide layer being continuously adhered to said upper surface.

15. (Thrice Amended) An interconnect in an electronic device comprising:

a metallic structure disposed within a first silicon oxide layer, said metallic structure having an upper surface and including:

a titanium liner layer disposed within an interconnect corridor in said first silicon oxide layer;

a titanium nitride layer disposed upon said titanium liner layer; and

a tungsten film disposed upon said titanium nitride layer;

a first passivation layer disposed upon said upper surface and comprised of a tungsten nitride compound;

a second passivation layer consisting essentially of a nitrogen-containing silane disposed [comprising ammonia and derivatives thereof adsorbed] upon said first passivation layer; and

a second silicon oxide layer disposed upon said first silicon oxide layer and upon said upper surface, said second silicon oxide layer being continuously adhered to said upper surface.

16. (Thrice Amended) An interconnect in an electronic device comprising:

a metallic structure disposed within a first silicon oxide layer, said metallic structure having an upper surface and including:

a titanium liner layer disposed within an interconnect corridor in said first silicon oxide layer;

a titanium nitride layer disposed upon said titanium liner layer; and

a tungsten film disposed upon said titanium nitride layer;

a passivation layer disposed upon said upper surface and consisting essentially of a nitrogen-containing silane [comprised of ammonia and derivatives thereof adsorbed upon said upper surface]; and

a second silicon oxide layer disposed upon said first silicon oxide layer and upon said upper surface, said second silicon oxide layer being continuously adhered to said upper surface.

17. (Twice Amended) A semiconductor structure comprising:

an electrically conductive interconnect disposed within a first dielectric layer, said electrically conductive interconnect having an upper surface;

a first passivation layer disposed upon said upper surface, said first passivation layer comprising a tungsten nitride compound;

a second passivation layer comprising multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption], said second passivation layer comprising ammonia and derivatives thereof]; and

an interlayer dielectric disposed upon said first dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.

19. (Twice Amended) An interconnect in an electronic device comprising:

a metallic first structure disposed within a first silicon oxide layer, said metallic first structure having an upper surface;

a first passivation layer disposed upon said upper surface, said first passivation layer comprising a tungsten nitride compound;

a second passivation layer comprising multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption], said second layer comprising ammonia or derivatives thereof]; and

a second silicon oxide layer disposed upon said first silicon oxide layer and upon said upper surface, said second silicon oxide layer being continuously adhered to said upper surface.

29. (Once Amended) A semiconductor structure comprising:
 an electrically conductive interconnect disposed within a first dielectric layer, said electrically conductive interconnect having an upper surface;
 a passivation layer disposed upon said upper surface, said passivation layer consisting essentially of [comprising] a nitrogen-containing silane [adsorbed upon said upper surface]; and
 an interlayer dielectric disposed upon said first dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.
30. (Once Amended) A semiconductor structure comprising:
 an electrically conductive interconnect disposed within a first dielectric layer, said electrically conductive interconnect having an upper surface;
 a first passivation layer [disposed] upon said upper surface, said first passivation layer comprising a tungsten nitride compound,
 a second passivation layer [adsorbed] upon said first passivation layer, said second passivation layer [comprising] consisting essentially of a nitrogen-containing silane; and
 an interlayer dielectric disposed upon said first dielectric layer and upon said upper surface, said interlayer dielectric being continuously adhered to said upper surface.